Trinity Alps Wilderness Prescribed Fire Project

Climate Change Resource Report

Prepared by:

Anna E. Hammet
Biological Scientist
VMS Enterprise Unit

Updated by:

Stephanie Riess
Environmental Coordinator
Trinity River Management Unit

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Introduction

This report analyses the potential effects of the Trinity Alps Wilderness Prescribed Fire Project on climate change. Potential effects from the alternatives were assessed within the context of direct, indirect and cumulative effects to climate change, the effects of climate change on the proposed activities, and information required for findings under the National Environmental Policy Act (NEPA).

Regulatory Framework

Federal Laws

National Forest Management Act

The National Forest Management Act (NFMA) [16 U.S.C.1604(b), (f), (g) and (o)] requires the development, maintenance, amendment and revision of land and resource management plans (forest plans) for each unit of the National Forest System. The forest plans help create a dynamic management system so that an interdisciplinary approach to achieve integrated consideration of physical, biological, economic and other sciences will be applied to all future actions on the unit.

NFMA requires that project be consistent with the applicable forest plan. Forest plan guidance for the Shasta-Trinity National Forest is discussed below.

State and Local Laws

In 2005, then-Governor Schwarzenegger signed California Executive Order S-3-05, which required an 80 percent reduction in greenhouse gases from 1990 levels by 2050 (State of California 2005).

In 2006, California enacted Assembly Bill 32, The Global Warming Solutions Act, which required a scoping plan for achieving reductions in greenhouse gas emissions by 2020 (California Air Resources Board 2006). The bill's scoping plan contains the main strategies California will use to reduce the greenhouse gases that cause climate change. Reducing our emissions by 80 percent will require California to develop new technologies that dramatically reduce dependence on fossil fuels. This includes achieving a statewide renewable energy mix of 33 percent.

"Carbon Sequestration: The Plan" describes California's role in the West Coast Regional Carbon Sequestration Partnership, a public-private collaboration to characterize regional carbon capture and sequestration opportunities. The plan also acknowledges the role of terrestrial sequestration in forests, rangelands, wetlands and other land resources. The 2020 Scoping Plan target for California's forest sector is to maintain the current 5 million metric tons of carbon dioxide (CO_2) equivalent of sequestration through sustainable management practices (California Air Resources Board 2008).

Agency Goals and Objectives

US Department of Agriculture Strategic Plan for FY 2010-2015

Goal 2 of the USDA Strategic Plan for FY 2010-2015 (USDA 2010) states: "Ensure our National Forests and private working lands are conserved, restored and made more resilient to climate change, while enhancing our water resources."

- Objective 2.2 (Lead Efforts to Mitigate and Adapt to Climate Change) strategies and means include incorporating climate change mitigation and adaptation strategies into management practices and using scientific findings for all restoration projects, planning and prescriptions.
- Objective 2.4 (Reduce Risk From Catastrophic Wildfire and Restore Fire to Its Appropriate Place on the Landscape) strategies and means include safely managing wildland fire and promoting the appropriate use of prescribed fire to restore fire as a natural ecological process on the landscape, improve forest and habitat conditions, and reduce fuel loads and catastrophic fire risk.

Forest Service Strategic Plan FY 2007-2012[1]

The Forest Service Strategic Plan for FY2007-2012 (USDA Forest Service 2007) did not contain goals and objectives specific to climate change; however, it did contain goals to produce and maintain the health and productivity of National Forest lands. Goal 1 in the plan is to restore, sustain and enhance the nation's forests and grasslands. In achieving this goal, forests will maintain their health, productivity, diversity and resistance to unnaturally severe disturbance. Means and strategies to accomplish this goal include maintaining resilient land and water conditions at the watershed level and reducing adverse impacts from invasive and native pests and diseases (USDA Forest Service 2007).

Forest Service Strategic Framework for Responding to Climate Change

The Forest Service Strategic Framework for Responding to Climate Change (USDA Forest Service 2008) provides a strategic framework for the Forest Service to guide current and future actions to meet the challenges of climate change. Strategies to address climate change encompass two components:

1. Facilitated Adaptation – which refers to actions to adjust to and reduce the negative impacts of climate change on ecological, economic and social systems, and
2. Mitigation – which refers to actions to reduce emissions and enhance sinks of greenhouse gases so as to decrease inputs to climate warming in the short term and reduce the effects of climate change in the long term.

Forest Service National Roadmap for Responding to Climate Change

The National Roadmap for Responding to Climate Change (USDA Forest Service 2011) was written to respond to the goal of bringing all national forests into compliance with a climate change adaptation and mitigation strategy. The "Roadmap" identifies the Forest Service

[1] The Strategic Plan has not yet been updated; however, the goals and objectives set forth in the current document are still considered to be valid.

management response to climate change on the ground as threefold: adaptation, mitigation and sustainable consumption.

Response to climate change will be through adaptive restoration – restoring the functions and processes characteristic of healthy, resilient ecosystems so that they can withstand the stresses and uncertainties associated with climate change. Mitigation strategies include promoting the uptake of atmospheric carbon by forests and indirectly reducing greenhouse gas emissions (USDA Forest Service 2011).

2012 Planning Rule

On May 9, 2012 a new U.S. Forest Service Planning Rule became effective. The new planning rule complements the Agency's climate change response. It was designed to address topics such as ecosystem resilience, collaboration, science-management integration, local and broad-scale monitoring, and an "all-lands approach" to land management (USDA Forest Service 2012).

Forest Plan

The Shasta-Trinity National Forest Land and Resource Management Plan (Forest Plan) (USDA Forest Service 1995) does not provide standards and guidelines specific to climate change. It does, however, provide guidance for the following resources that are pertinent to this project.

Forest Plan Goals, Standards and Guidelines

Forest Plan goals related to aspects of climate change that are pertinent to this project include the following:

<u>Air Quality</u> – "Maintain air quality to meet or exceed applicable standards and guidelines" (Forest Plan, page 4-4). Air pollutants of concern include CO_2 as a constituent.

<u>Fire and Fuels</u> – "Restore fire to its natural role in the ecosystem when establishing the Desired Future Condition of the landscape" (Forest Plan, page 4-4).

Forest Plan standards and guidelines related to aspects of climate change that are pertinent to this project include the following:

<u>Standard and Guideline 4-1.a</u>: Protect air quality while achieving land and resource management goals and objectives… (Forest Plan, page 4-13).

<u>Standard and Guideline 4.8d</u>: Plan and implement fuel treatments emphasizing those treatments that will replicate fire's natural role in the ecosystems (Forest Plan, page 4-17).

Management Area and Management Prescription

The Trinity Alps project is located in Management Area 4 – Forest Wilderness Areas and is entirely within the Trinity Alps Wilderness. The project area is within Management Prescription V – Wilderness Management. There is no management direction for the Trinity Alps Wilderness specific to climate change. However, the following supplemental direction for the Alps applies:

<u>Supplemental Direction D4</u>: Develop a fire management plan which uses planned and unplanned ignition to restore and maintain natural conditions. When implementing this plan, maintaining air quality is an overriding consideration (Forest Plan, page 4-95).

Other Guidance or Recommendations

Watershed Analysis

The Trinity Alps project area falls within the boundaries of the New River Watershed Analysis (USDA Forest Service 2000). There is no discussion regarding forest ecosystems and climate change; however, the following air quality-, fire- and fuels- related issues were addressed:

- The continuity and level of fuels poses an increased fire hazard across the landscape of the New River area with a high potential for high intensity re-burn.
- Communities that are surrounded by a fire prone forest will always have a potential threat to life and property.
- Management actions are possible to reduce adverse impacts to air quality related to wildfires.

Resource Concerns Identified Through Internal and External Scoping

Public scoping did not generate comments or issues directly related to climate change. Internal scoping did not identify particular concerns regarding climate change. Because the proposed activities are related to certain aspects of climate change and/or may affect or be affected by climate change (e.g., air quality, fire and fuels), the following indicators were used to analyze the effects of the project on climate change.

Issue and Issue Indicator Related to Climate Change

Given that the project area is entirely within designated wilderness, active management emphasizes maintaining wilderness values (e.g., an unmodified natural environment with opportunities for isolated and solitary experiences) through promotion and restoration of natural ecosystem processes. The project was designed to reduce the risks and consequences of future wildfires by reducing unnaturally high fuel loadings, to move the project area toward historic fire regime conditions, and to reduce the adverse effects of future wildfires with regard to hazardous air conditions.

The issue indicator for achieving the above objectives is acres treated to reduce fuels and restore fire as an ecosystem component, thereby moving the project area toward more resilient patterns of vegetation and disturbance.

Alternatives

Alternative 1

No prescribed fire or related treatments would be implemented under Alternative 1. This alternative provides a baseline of conditions used to compare the environmental effects of the action alternatives.

Proposed Action (Alternative 2)

Alternative 2 proposes maintenance as needed along approximately 32 miles of existing fireline followed by approximately 16,709 acres of prescribed fire.

Proposed treatments consist of igniting prescribed fire along ridge tops to create a mosaic burn severity pattern, primarily of low- to moderate-severity surface fire as the fire backs down the slope. Prescribed fire would consist of aerial ignition using helicopters (plastic sphere dispenser and/or helitorch) and/or hand lighting methods. Helicopter flight time within wilderness would average approximately 4 to 5 hours in a given day, would be intermittent rather than continuous, and would be based on weather and burning conditions. Approximately two days of intermittent helicopter presence (4-5 non-contiguous hours per day) within wilderness per year for up to ten years are expected.

All fireline maintenance would be by non-motorized methods (e.g., ground crews using primitive tools such as crosscut saws, pry bars and manual grip hoists). The use of chainsaws during fireline maintenance would be limited to situations in which it is determined that use of crosscut saws would be unsafe (e.g., felling of danger trees that cannot be safely avoided or otherwise abated).

Alternative 3 – Additional Treatment Areas

Alternative 3 would add approximately 2,379 acres to the treatments proposed under Alternative 2; a total of approximately 19,088 acres of prescribed fire would occur under this alternative. No additional fireline maintenance beyond that proposed under Alternative 2 would occur under this alternative. Implementation of this alternative would not be expected to increase helicopter flight time beyond the predicted 4-5 non-contiguous hours per day for two days per year under Alternative 2. As with Alternative 2, implementation of this alternative would occur during a period of up to ten years.

Design Features Common to Both Action Alternatives Relevant to Climate Change

While no project design features specific to climate change were developed, design features for air quality and prescribed fire would minimize effects to air quality and, therefore, may indirectly reduce the effects of project activities on climate change.

Air Quality

Implementation of prescribed fire would comply with applicable Federal, State and Trinity County Air Quality Management District (AQMD) air quality laws and regulations concerning overall project emissions with emphasis on prescribed burning coordination, emissions and smoke impacts mitigations.

1. A smoke management plan would be developed in accordance with AQMD direction and submitted to the AQMD prior to implementation of prescribed fire.
2. Prescribed burning during periods of high public use would be avoided or mitigated through smoke management procedures that would minimize impacts to areas of high public use.

Fire / Fuels

A detailed prescribed fire implementation plan (burn plan) would be completed prior to implementation of prescribed fire. The burn plan would include all elements required by Forest Service Manual (FSM) 5140 and the Interagency Prescribed Fire Planning and Implementation Procedures Guide.

Analysis Methodology

Project-level analysis considers two types of climate change effects – the effect of a proposed project on climate change and the effect of climate change on a proposed project (USDA Forest Service 2009).

Analysis and determination of effects with regard to climate change are by necessity qualitative rather than quantitative given the lack of reliable models available to quantify effects at the project, local or even regional level.

Information Sources

We reviewed current publications, peer reviewed literature and studies to analyze the effects of the alternatives on climate change and the effects of climate change on the project. While models to predict changes in carbon storage and release exist, the Forest Service does not have an accepted tool for analyzing all greenhouse gas emissions at the local or regional level.

A summary of current and predicted future trends in climate and climate-driven processes for the Shasta-Trinity National Forest and surrounding lands (Butz and Safford 2011) is included in the project record.

Cumulative Effects Analysis

Analysis at the local level is not possible due to the lack of available local data and to the fact that carbon releases from the project would enter the global pool of atmospheric carbon (no containment). Data related to climate change are available at the local scale; however, the project is too small for meaningful analysis at that scale. Qualitative carbon sequestration as indicated by acres treated to reduce fuels and restore fire as an ecosystem component is considered at the project area and State levels. Carbon sequestration and forest stand resiliency pertain to the life of the stand, or several hundred years.

Desired Condition

Forested landscapes capable of adapting to changing conditions will be more likely to store carbon sustainably (USDA Forest Service 2011). We assume that climate change is an undesirable condition, at least partly due to an increase in greenhouse gases in the atmosphere – including carbon dioxide (CO_2). Given the direction to manage the Trinity Alps Wilderness – and therefore the project area – with an emphasis on preserving wilderness values by maintaining and promoting natural ecosystem processes, the desired condition for the project area with regard to climate change is as follows:

- a landscape in which carbon sequestration would occur at or near natural or historic levels;

- a landscape that is resilient to large-scale, stand-replacing wildfires, and in which fire is restored to its historic function within the Alps ecosystem;
- a landscape in which the risks and consequences of public health and safety concerns caused by hazardous air conditions are reduced.

Affected Environment

Introduction

Ongoing climate change research has concluded that, on a global scale, climate is changing; that the change will accelerate; and that human greenhouse gas emissions – primarily carbon dioxide (CO_2) emissions – are the main source of accelerated climate change (USDA Forest Service 2009). Climate change models and the predicted effects on different regions around the world show wide variation, with some regions greatly affected while others less affected. Regional trends over the last century are linked to climate change (Butz and Safford 2011).

Regional Trends

Regional trends linked to climate change are related to forest structure, hydrology and forest fires.

Forest Structure

Fire exclusion over the past 100 years has resulted in increased tree densities and a reduction in shade-intolerant species. Widespread increases in tree mortality in old growth forests across the west, including northern California, have been documented, with the mortality attributed to regional climate warming and associated drought stress (Butz and Safford 2011).

Hydrology

Analyses of hydrometeorological data from the lower Klamath Basin show a decrease in the percentage of precipitation falling as snow and accelerated snowpack melt, resulting in earlier peak runoff and lower base flows. Since the 1940s, snow water equivalent (SWE) has decreased while water use has increased (Butz and Safford 2011).

Forest Fires

Data on forest fire frequency, size, total area burned and severity all show strong increases in California over the last two to three decades. Northern California forests have had substantially increased wildfire activity, with most wildfires occurring in years with early springs, and is likely attributable to both climate and land-use effects. Regarding effects, large percentage changes in moisture deficits in northern California forests were strongly associated with advances in the timing of spring (Butz and Safford 2011).

Fire suppression has led to fuel-rich conditions, and most future climate modeling predicts climate conditions that will likely exacerbate these conditions, thus increasing the likelihood of large fire occurrence. Westerling and others (2006) showed that increasing frequencies of large fires (>1000 acres) across the western United States since the 1980s were strongly linked to increasing temperatures and early spring snowmelt.

Rising temperatures, changing precipitation patterns and declining soil moisture trends have shifted the suitable range for many tree species to higher elevations. With higher rainfall to snowfall ratios and higher nighttime minimum temperatures, broadleaf trees (especially oak species) are predicted to become an increasingly important component of conifer-dominated forests. Higher temperatures also correlate with longer summer drought conditions which, in turn, increase drought stress on seedlings and increase wildfire risk. Mitigating increased disturbance from high-severity wildfires, while promoting species diversity, is the likeliest strategy to enhance ecosystem resilience in the face of climate change (Skinner 2007).

Local Trends

A summary of current and probable future trends in climate and climate-driven processes for the Shasta-Trinity National Forest and surrounding lands was completed in 2011 (Butz and Safford 2011). The summary examined weather station data for temperature and precipitation from six weather stations on or adjacent to the forest. The Big Bar and Weaverville weather stations are closest to the project area. The following information on local trends is derived from the summary.

Temperature

The summary contains no weather station data from elevations above 3600 feet, but the highest station available (Mt. Shasta) shows no change in mean annual temperature since 1949 (although daily maximum temperatures are slightly higher). The Weaverville weather station exhibits significant increases in average temperatures of about 1-2° F; this trend is being driven by highly significant increases in mean minimum (i.e. nighttime) temperatures of 2-3° F. The Big Bar meteorological record was considered too discontinuous to interpret for temperature.

Precipitation

There is very high variability in the Weaverville station annual precipitation records, such that the actual annual mean can't be predicted with accuracy. The Big Bar station's annual precipitation trend is based on too few data to allow interpretation.

The 5-yr coefficient of variation of annual precipitation is steady at the Big Bar Ranger Station and increasing over time at Weaverville. An increasing coefficient of variation in annual precipitation means that year-to-year variability in precipitation has increased over the course of the last century, while a steady coefficient of variation denotes that year-to-year variability remains relatively stable. Total annual snowfall records on the forest are too incomplete to allow for analysis.

Regional Projections

Temperature

California's climate is expected to become warmer during this century. During the next few decades, average temperatures are projected to rise between 1 and 2.3°F. Toward the end of this century, statewide average temperatures are expected to rise between 3 and 10.5°F, depending on various scenarios based on population growth, economic development and control of heat-trapping emissions (California Climate Change Center 2006). The most common prediction among recent models is temperature warming by 9°F by 2100 (Butz and Safford 2011).

Precipitation

Although predictions differ between models, on average projections show little change in expected total annual precipitation or in seasonal precipitation patterns in California (California Climate Change Center 2006). The most common prediction among recent models is that precipitation will remain similar or be slightly reduced compared to today (Christensen et al. 2007, Butz and Safford 2011). Most models predicted that summers will be drier than they are currently, regardless of levels of annual precipitation (Butz and Safford 2011).

With the projected rise in statewide average temperatures, more precipitation will fall as rain instead of snow, and the snow that does fall will melt earlier, reducing the Sierra Nevada spring snowpack by as much as 70 to 90 percent. If global warming emissions are significantly curbed and temperature increases are kept in the lower warming range, snowpack losses are expected to be only half as large as those expected if temperatures were to rise to the higher warming range. A hotter, drier climate could promote up to 90 percent more wildfires in northern California by the end of the century by drying out and increasing the flammability of forest vegetation (California Climate Change Center 2006).

With climate change, streams in the west may experience reduced annual runoff, and reduced flows are expected to contribute to contraction or loss of wetlands. Water temperatures are expected to increase, as is erosion. Therefore, sediment loads are also expected to increase, which would affect aquatic habitats (Furniss et al. 2010).

Local Projections

While no modeling specific to the Trinity Alps project area exists,[2] a downscaling of three climate models for the Rogue River Badin in southwest Oregon and the Klamath River Basin led to a similar projection for northwest California that precipitation my remain roughly similar to historical levels but may shift in seasonality to occur predominantly in mid-winter months. Rising temperatures will increase the percentage of precipitation falling as rain and decrease snowpack considerably, resulting in drier summers. Both wet and dry cycles are likely to last longer and to be more extreme, leading to periods of deeper drought as well as periods of more extensive flooding (Butz and Safford 2011).

In California, conditions suitable for hardwood forests (oaks, tanoak, madrone, etc.) are projected to expand, while those suitable for conifer-dominated forests are projected to contract. Significant declines in evergreen conifer forests have been predicted in inland northwest California, with subsequent replacement by Douglas-fir/tanoak forest, tanoak/madrone/oak forest, and oak woodlands under most future climate change scenarios (Butz and Safford 2011).

Climate Change and Wildfire Severity

Published accounts illustrate the increased intensity of fires over the last 25 years (Miller et al. 2009, Spies et al. 2006). Miller and others (2009) noted a significant relationship between climate and forest fire activity from the early 20th century through 2006 in the Sierra Nevada and southern Cascade Mountains, with an increasing correlation between precipitation and temperature during the fire season. During the temporal span of their study, particularly over the

[2] To date no published climate change or vegetation change modeling has been conducted for the Shasta-Trinity National Forest. Few future-climate modeling efforts have treated areas as restricted as the State of California. The principal limiting factor is the spatial scale of the General Circulation Models that are used to simulate future climate change scenarios (Butz and Safford 2011).

last 25 years, researchers noted a correlation between increased fire severity and increased annual precipitation (Miller et al. 2009). Precipitation accounted for all or most of the variance in the latest period models.

The increase in fire severity was attributed to increased fuel loadings, and was presumed to be due to a combination of fire suppression and augmented vegetation growth due to increases in precipitation. Peak snowmelt is occurring earlier, fire season is lengthening, summer drought is deepening, and forest fuels are possibly at all-time highs (Miller et al. 2009).

Climate Change and Adaptation

Under some predictive scenarios, changes in climate may occur that exceed the capacity of existing forest tree populations to adjust physiologically and developmentally. In addition, climate change may occur at rates that exceed the capacity of forest species to adapt to new conditions or to migrate to more favorable environments. The forest trees living today will probably comprise much of the forests of the next century (Anderson 2008).

Limitations in the Wilderness Act legislation preclude the use of vegetation treatments within designated wilderness other than prescribed fire, except as reserved by the Chief of the Forest Service. Therefore, vegetation management in the project area is designed to support other ecosystem goals within the Trinity Alps Wilderness. That said, adaptive actions to climate change can occur inadvertently, with the reduction of vulnerability to climate change being an unintended consequence of changes in fire management and suppression strategy (Trainor et al. 2009).

Carbon Cycling

Long-term carbon storage is a function of climate and its effects on fuels, ignitions, and fire severity over time and space, as well as the normal processes of tree growth and decomposition. The amount of carbon removed from the atmosphere is controlled by rates of growth, plant respiration and decay (Mader 2007). In mixed conifer forests, where surface fire effects historically dominated (Agee et al. 2005, Hessburg et al. 2007), rebalancing of carbon occurred by constant thinning and consumption of surface and ladder fuels by frequent, low-and mixed-severity fires (where surface fire effects were dominant), and occasional via patches of stand-replacing fire.

According to Restaino and Peterson (2013), sequestration of carbon in forests has the potential to mitigate the effects of climate change by offsetting future emissions of greenhouse gases. However, in dry temperate forests, wildfire is a natural disturbance agent with the potential to release large fluxes of carbon into the atmosphere. Climate-driven increases in wildfire extent and severity are expected to increase the risks of reversal to carbon stores and affect the potential of dry forests to sequester carbon. In the western United States, fuel treatments that successfully reduce surface fuels in dry forests can mitigate the spread and severity of wildfire, while reducing both tree mortality and emissions from wildfire (Restaino and Peterson 2013).

Carbon Cycling and Forest Management

Forest management activities proposed for this project that are related to climate change include application of prescribed fire and related use of equipment.

Emissions from Equipment Usage

Restaino and Peterson (2013) found that emissions of carbon from equipment usage during fuel treatments amount to a small percentage of the total aboveground carbon stock. There is far greater variability and magnitude in treatment-related carbon emissions from prescribed fire.

Emissions from Prescribed Fire

Agreement exists across observed and simulated treatments that prescribed fire constitutes a substantial proportion of treatment emissions (Finkral and Evans 2008, North et al. 2009, Stephens et al. 2009, Sorensen et al. 2011). Prescribed fire is effective at reducing fine surface fuels and horizontal fuel continuity (van Wagtendonk et al. 1996, Graham et al. 2004), but is not reliable for reducing tree density, crown density, or fuel ladders, often used in combination with thinning to achieve management goals (Gorte 2009).

Prescribed fire may consume substantial surface biomass, with smoldering consumption of the organic layer contributing to smoke and affecting soil nutrient cycling (Neary et al. 1999). Prescribed fire can generate fuels by killing understory trees (Agee 2003), and multiple treatments may be necessary to maintain reduced fire hazard over time.

Fuel treatments may effectively reduce disturbance severity with known carbon costs, yet the expected carbon benefits from fuel reduction are realized only when wildfire occurs (Ager et al. 2010, Hurteau and North 2010).

Carbon Loss from Wildfire

In addition to releasing stored carbon to the atmosphere, intense wildfire can remove carbon from surface soils, emit large quantities of other greenhouse gases, result in large amounts of decomposing woody material, and consume large areas of forest as a mechanism for removing atmospheric carbon. Depending on the forest type, the area burned by a stand-replacing fire does not recover its pre-fire carbon stock for decades (Janisch and Harmon 2002).

The potential trade-off to initial net carbon losses associated with fuel reduction treatments is a decreased risk of future high-severity wildfire and its associated release of carbon to the atmosphere (Hurteau et al. 2008). In dry forests, fuel treatments that successfully reduce surface fuels have been shown to mitigate the spread and severity of wildfire (Fulé et al. 2001, Pollett and Omi 2002, Skinner et al. 2004, Peterson et al. 2005, Omi et al. 2006, Safford et al. 2009, Stephens et al. 2009, Prichard et al. 2010). Some recent studies use results from wildfire simulations to suggest that, in addition to reducing fire severity, fuel treatments may reduce emissions from wildfire (Finkral and Evans 2008, Hurteau et al. 2008, Hurteau and North 2009, Stephens et al. 2009, Reinhardt and Holsinger 2010, Sorensen et al. 2011).

However, other studies suggest that fuel treatments are unlikely to benefit carbon storage and may result in a reduction of overall carbon stocks (Mitchell et al. 2009, Ager et al. 2010, Campbell et al. 2011). Few empirical studies examine carbon emissions from study areas actually burned by wildfire (Campbell et al. 2007, Meigs et al. 2009, North and Hurteau 2011), and only one reports wildfire interactions in treated and untreated stands (North and Hurteau 2011).

Restaino and Peterson (2013) synthesized findings from these studies and compared the relative effects of fuel treatments and wildfire on carbon dynamics. They concluded that all studies agree unequivocally that untreated stands release more emissions to the atmosphere during wildfire than treated stands, and that emissions increase as burn severity increases. Tree mortality from wildfire is also consistently reduced by the presence of fuel treatments.

However, they also concluded that fuel treatments have a finite life expectancy, and fire hazard increases over time as fuels accumulate in treated areas. Repetition and maintenance of fuel treatments are necessary in order to effectively maintain reduced fire hazard over time (Peterson et al. 2005, Johnson et al. 2007, 2011) and thus must be included in analyses of long-term carbon storage.

Environmental Consequences

Alternative 1 - No Action

Direct, Indirect and Cumulative Effects

Effects on Carbon Cycling

Implementation of the no action alternative would have no direct effects on carbon cycling, since no activities would occur that would contribute to atmospheric carbon. Indirectly, the continued accumulation of untreated fuels in the project area would increase the risk that future wildfires would be widespread and of high severity (see the project Fire and Fuels Report). Carbon loss from widespread, high-severity fire would contribute to other sources of greenhouse gases at the project area and State levels.

Effects of Climate Change

Forest preservation, such as is generally practiced in wilderness management, can avoid CO_2 emissions. Net carbon storage will cease when the forest meets its biophysical equilibrium – when carbon inputs equal carbon outputs. Absent natural disturbance, the carbon stock then essentially becomes a static pool (US Environmental Protection Agency 2005).

Ongoing trends in the project area (e.g., continued accumulation of untreated fuels, fire suppression activities) would continue, with any change in conditions occurring due to natural processes and human-influenced trends from a global context over time, regardless of a no action decision. A landscape with unnaturally high fuel concentrations and in which suppression of fire continues would be less resilient to the predicted increases in wildfire severity as climate change progresses.

Effects Common to Alternatives 2 and 3

Direct and Indirect Effects

Effects on Carbon Cycling

Implementation of the proposed fuel treatments would result in some short-term releases of carbon, both from prescribed fire and from use of helicopters (and possible occasional use of chainsaws in fireline maintenance). Short-term emissions of carbon from the proposed activities would occur over a 1-2 day period for approximately 6-10 years. Helicopter flight time is predicted to be essentially the same for both action alternatives.

The burning prescription would favor conditions that would promote mostly low- to moderate-severity surface fire, with limited amounts of high-severity fire (see the project fire and fuels report). Air quality design features would minimize harmful emissions during project implementation as well as reduce predicted emissions from future wildfires (see the project air quality report). Fuel reduction would be achieved on approximately 16,709 acres under Alternative 2 and 19,088 acres under Alternative 3.

Effects of Climate Change

Although future climate change at the local level is uncertain, implementation of either action alternative would reduce the risk of future high-severity fires (see the project fire and fuels report), thereby improving the resiliency of the project area to drier or seasonally drier conditions. If the local climate shifts toward wetter conditions, reduction of current fuel levels would not have a detrimental effect. Moving the project area toward historic fire regime conditions would likely enhance the ability of project area ecosystems to adapt to climate change, whether the shift is toward drier or wetter conditions.

Cumulative Effects

As noted above, future fire behavior in the project area (as discussed in the project fire and fuels report) is predicted to be much lower than under the no action alternative. Short-term emissions of carbon from the proposed activities would likely be offset in the event of a future wildfire occurring in or adjacent to the project area.

At the global scale, either action alternative would have a negligible effect on climate change. Because greenhouse gases from project activities would mix readily into the global pool of greenhouse gases, it is not possible to determine the indirect effects of emissions from single or multiples sources (e.g., at the project level). In addition, because most Forest Service projects are quite small in the context of global atmospheric CO_2, it is not currently possible to conduct a confident, quantitative analysis of actual climate change effects based on individual or multiple projects (USDA Forest Service 2009).

Available data indicate that 33 million acres of forest in California store an estimated 1,333.9 million bone-dry tons of carbon in live trees, snags and down wood (Christensen et al. 2007). The 58,349-acre project area represents a small portion (0.17 percent) of forest lands in California; proposed treatments constitute and even smaller portion (16,709 acres or 0.04 percent under Alternative 2 and 19,088 acres or 0.05 percent under Alternative 3). By contrast, one wildfire (the 1999 Megram fire) burned over 49,000 acres within the project area, with 40 percent of those acres experiencing moderate- or high-severity fire and large areas of overstory loss, which – as noted above – contributes more atmospheric carbon than the lower severities typical of prescribed fire.

The benefits of fuel reduction would likely begin to decline after about 15-20 years, at which time additional prescribed fire treatments may be needed – depending on occurrence of wildfire and other natural disturbance in the project area.[3] These treatments would result in additional short-term releases of carbon, but would be expected to emulate emissions from mostly low- to moderate-severity surface fire, which occurred historically in the project area.

[3] Any future treatments beyond those proposed in this EA would be analyzed in a new NEPA document.

Alternative 3 – Additional Treatments

Direct Effects

Because Alternative 3 would treat fuels in the Virgin Creek drainage, the benefits of fuel reduction and enhanced landscape resilience would be realized over a larger area than under Alternative 2. The 2,379 additional acres of prescribed fire would contribute slightly more short-term carbon loss than Alternative 2.

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